



C&O Canal STEM Activity – Build a Lift Lock

Design a lift lock using simple materials in the classroom.

Activity Time: 60-120 minutes

This can be an individual, group or whole class activity.

Suggested materials: Recyclable materials including cardboard, paper, paper towel roll, plastic bottles and caps; glue, tape and/or adhesive material; rope or string; paint, markers (optional).



Teacher Idea: Work with art teacher to complete lesson or identify materials.

Directions:

Step 1: Watch the Pre visit video “Locking Through” asking students to examine the lock. <http://www.nps.gov/choh/photosmultimedia/multimedia.htm> and read “How a lock works” handout (page 3).

Step 2: Complete and review page 5 in the Junior Ranger Booklet “Locking Through” and examine how a canal lift lock operates.

Step 2: Review the scope of work to provide students with facts and questions to consider when designing/building their lift lock (see page 2).

Step 3: On a blank sheet of paper, ask students to design their own lift lock. This will include a detailed sketch of their design with parts identified and labeled.

Step 4: Using recyclable materials, ask students to build a lift lock. It is okay if the lift lock is not identical to the canal lift lock. The goal is for students to create their own design.

Scope of work for lift lock design

SIZE

1 inch represents 10 feet

Lift locks must be at least 10 inches long to accommodate a 95 foot canal boat.

Lift locks must be at least 2 inches wide to accommodate a 15 foot canal boat.

Will your lock move boats larger than canal boats? Will it move more than one boat at a time? If so, how long/wide will you make your boat?

WORKING PARTS

Lift locks raise and lower boats on a body of water. To do this, boats must be able to enter and exit the lock from a body of water, such as a canal, river or lake.

How will boats be able to enter and exit your lift lock design?

Canal lift locks have specially designed gates (doors) called miter gates. Miter gates close at an angle to hold back thousands of pounds of pressure from the water in the lock.

How does your lock hold water?

WATER

How will water be used to raise and lower boats in the lift lock?

How will water enter your lift lock? How will it exit?

Where will the water come from?

Who will control the water coming in and out of the lift lock? How will they do this?

How a lock works

A lock is a device for raising and lowering boats between stretches of water of different levels on river and canal waterways. The distinguishing feature of a lock is a fixed chamber whose water level can be varied.

Locks have three elements:

- A watertight **chamber** connecting the upper and lower canals, and large enough to enclose one or more boats and the chamber's water level can vary.
- Two **gate doors** at either end of the chamber. The two doors of the gate are opened to allow a boat to enter or leave the chamber; when closed, the gate is watertight.
- A **valve** that allows water both in and out of the chamber.

To move upstream, a boat enters the lock through the lower gate and the gate doors are closed. The boat now sits in the bottom of the lock chamber and will need to rise eight feet to become even with the lock walls and the water level upstream.

Each gate door has two small paddles at the bottom. These paddles are connected to metal rods that run vertically up the height of the door. These rods stick out the top of the doors several feet. By using a lock key, essentially a giant wrench, a crew member can twist the metal rods and open the paddles.

When it is time to fill the lock with water and raise the boat, the four paddles on the upstream gate are opened one at a time. A total of 90,000 gallons of water will rush in over several minutes. This will raise the surface of the water until it is level with the water upstream.

As the water comes and the chamber is filled, the boat will need to be stabilized to prevent the rushing water current from crashing it into the lock walls. This can be accomplished either by using the engine to steer the boat accordingly or by crew members using boat poles.

While there remains any difference in surface level between the water inside the lock chamber and the water upstream, the upper gate is impossible to open because of the accumulated pressure on the upstream side. As soon as the water levels, and therefore the water pressure, are equal on either side of the gates, the doors can open. The boat can then continue traveling upstream.

To move downstream, the process is basically reversed. The boat enters the lock with the chamber already filled with water. The gate doors are closed behind it. The boat will now have to be lowered eight feet in order to continue downstream. The four paddles of the downstream gate doors are opened, releasing 90,000 gallons of water out of the chamber and into the next level. Again, the boat will have to be stabilized in position as the water level decreases. Once the water levels and pressure are equalized on either side of the downstream gate, the doors will open and the boat can continue downstream.